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The Mathematics Required In Vocational Courses In Kansas High Schools and A Projected Course of Study To Meet Those Requirements

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The Mathematics Required in Vocational Courses in Kansas High Schools and A Projected Course of Study to Meet Those Requirements

being

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by

Nova Grant Moody, B. S. in Education
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PART I

CHAPTER I

INTRODUCTION

American society is not static. Educators are faced with the problem of adapting education to a changing social situation. Many formulae have been introduced and given a trial. Vocational training is one of those formulae and the writer is interested in increased emphasis upon such training in our high schools. Vocational training for high school boys and girls has the advantage of purposeful activity and provides for individual differences in a way that some other courses have not done, possibly cannot do. America has witnessed a gradual lengthening of the annual school term and extension of the formal schooling period since 1900. So long as the unemployment problem persists in the adult population such an extension of compulsory school attendance is likely to continue. The ease of motivation and consequent holding power of vocational courses renders that field of education a fertile area for research investigation.

Vocational teachers complain about the inadequacy of certain foundation courses in the elementary school, notably mathematics, and not without justification. In a public school testing program, Reed,[1] of the Fort Hays Kansas State College, found that in rural schools particularly there is a progressive decline from the norm in arithmetic

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1. This statement is taken from unpublished results as presented to educational measurements classes by Dr. H. B. Reed in the summer of 1936.

computation as measured by The Modern School Achievement Tests.[2] Whatever the cause, the fact that the achievement of seventh and eighth grade children is farther below their capacity than lower grade children is a situation to be admitted and provision made for its correction.

Add to this condition the clamor of both educators and patrons for justification of algebra and geometry as required subjects in high school and reason for the writer, himself a mathematics teacher, to be interested becomes evident. Some encouragement is offered by Eaton[3] who states

> ....It is possible that there is a residual content of mathematics over and above the arithmetic of the elementary school which may justify the segregation of high school boys who are to be farmers, of high school boys who are not going to be farmers, and of high school girls, into a group for the study of that residual content...It may be that the simple algebraic equation and the mensuration aspects of geometry are of sufficiently frequent usability to be retained and to serve in the life of the ordinary individual. But the extraordinary expenditure of time and effort upon the part of the high school pupil now demanded, at the expense of complete sacrifice of learning in far more significant fields, in the study of the highly teachable standard subjects of algebra and geometry, must be given over.

With such a suggestion the writer has been led to this investigation of "The Mathematics Required in Vocational Courses in Kansas High Schools and A Projected Course of Study to Meet Those Requirements."

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2. By Arthur I. Gates, et al. New York. Bureau of Publications, Teachers College, Columbia University, 1931.

3. Eaton, Theodore H. Vocational Education in Farming Occupations, p. 191.

Purpose

The purpose of this investigation is (1) to identify the mathematical knowledge requisite to efficient participation in Kansas high school vocational courses; then (2) to arrange this mathematical knowledge into an outlined course of study for teacher guidance in a mathematics course of unit credit for high school students.

In this study "Vocational Courses" shall be taken to mean Vocational Agriculture and Vocational Home Making as offered in Kansas high schools. No other vocational subjects are approved by the Kansas State Board for Vocational Education in public high schools of the state. "A Course of Study" shall be interpreted in the light of the definition,[4]

> ...the material, usually in pamphlet form, which sets forth for the teacher such items as the objectives and content of a given subject, and the activities and books to be used to accomplish desired results.

Procedure

The first step in the research process was to seek out sources of information about the content of vocational courses and practices in presentation. Among the sources consulted were: (a) bulletins and correspondence from representatives of the Kansas State Board for Vocational Education, (b) a few interviews with vocational teachers and

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4. Twenty-ninth Yearbook, National Society for the Study of Education, 1930, p. 65.

examination of their local courses of study, (c) certain selected textbooks and bulletins known to be used for reference in vocational instruction, and (d) two research investigations bearing on this problem. A definite lack of uniformity in textbooks, course of study manuals, and the absence of any statistics compiled by the state supervisors concerning the prevalence of certain practices in choice of reference material and sequence of topics combined to establish very narrow limits to the quantitative data possible. Within wide limits each and every vocational teacher formulates his or her own course of study from year to year and selects reference material to serve that course. The limitations are chiefly time allotments and local conditions; the specified purpose of vocational courses is that they shall serve local interests and be adapted to the ability of students who are enrolled. Extensive uniform requirements are non-existent.

The second step was to explore these sources of content and ascertain the types of mathematics involved. The relative frequency of types was not significant; if a concept was employed in but one situation and that concept was indispensable the writer held it necessary to teach that mathematical concept. In this connection frequent use of the terms processes, topics, and mathematical skills will be used. Processes shall be taken to mean such mathematical operations as the four fundamental operations, square root, cancellation, transposition, etc. Topics shall be taken to mean divisions of content for the purpose of making application of processes, e.g. discount, board measure, insurance, taxes, etc. Mathematical skills shall be inter-

preted to include both processes and topics; the term shall be particularly descriptive of percentage, decimals, fractions, and similar general topics.

The third step was to formulate the course of study. The subject matter was divided and sub-divided until quantities for daily assignments were reached. These assignments were arranged and rearranged to embody the advantages of psychological order wherever possible, reverting to logical order (in contrast to psychological) only under compulsion. In such situations it is probable that the logical is also the psychological arrangement.

The fourth and final step was to elaborate the course of study outline with suggestions to teachers and illustrative lesson presentations.

CHAPTER II

VOCATIONAL AGRICULTURE

Under the present set-up courses in vocational agriculture are offered to boys fourteen years of age and over. They are taught by specially trained teachers who are approved and paid in part by federal government agencies.[5] Teachers are employed for the calendar year and allowed a vacation of one month during the summer. A minimum course includes live-stock production and management with farm shop work the first year; crop production and soils management with farm machinery and farm motors in shop work the second year. Half the school day (continuous) is devoted to the vocational subjects, the other half to non-vocational or academic subjects. It has been found most satisfactory to have boys enter the first year course in the tenth grade, sophomore year of high school.[6] Vocational courses in agriculture are distinguished from general courses in agriculture offered by non-vocational high schools by extensive laboratory work and the conduct of practical home projects as part of the regular course, supervised and graded by the vocational teacher. Much of the mathematical content is found in this project work because of the

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5. Plans for Vocational Education in Kansas. Bulletin No. 7, 1927-32. Part III, p. 5 ff.

6. Kansas State Board for Vocational Education. Problems Involved in Establishing Departments of Vocational Agriculture in the Public High Schools in Kansas, Series A-1 (revised). Topeka. Feb. 1936. p. 9.

practical motive of profit earning. The work in farm shop mechanics is the other important source of mathematical content.

Farm Shop Mechanics

Pollom[7] employed a questionnaire in determining the "scope and content of the course as well as the percent of total shop time" devoted to each phase of farm mechanics. Exhibit I (p. 10) shows the ranking of fourteen phases of shop work and indicates the number of distinct and separate jobs enumerated under each phase. Exhibit II lists selected jobs enumerated by Pollom together with mathematical skills involved as identified by the writer.

Home Projects

An individual project has been defined as "the carrying on of a productive farm enterprise to its logical conclusion through its natural cycle on a scale sufficient to command the interest and respect of the boy." As previously stated these projects form a vital part of the course, are carefully supervised and included in the grade record of student achievement. When a boy selects a project in crops or live-stock production he embarks upon a business venture with educational

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7. Pollom, Lester B. A Study of the Farm Mechanics Courses in the Vocational Agricultural High Schools in Kansas. Bulletin published by the Kansas State Board Vocational Education, Series A-3, Nov. 1927.

value and potential financial profit at one and the same time. He is required to do some very careful planning and must keep very accurate records.

To meet these accounting requirements Evans and Hall[8] have designed project record books for both types of projects. These books are uniformly used throughout the entire state. An analysis disclosed a variety of mathematical skills, most of which are common to both books. In Exhibit III and Exhibit IV may be found a tabulation of the record book headings (abbreviated) with corresponding skills which are involved.

The uniform use of project record books as discussed is evidence for the statement that all forms of live-stock projects involve the same form of accounting and mathematical skills. The same is true for crop projects. It matters not whether a boy in Bird City be raising sheep, a boy in Holcomb raising turkeys, a boy in Winfield raising swine, or a boy in Lawrence keeping dairy cows the technique of the records is the same. Similarly the first boy may raise wheat, the second broomcorn, the third cotton and the fourth feed--the mathematics required is the same.

The farm mechanics courses and the individual projects in live-stock and crops production seem also to be comprehensive of all the required mathematics. The validity of content of any local course of study or selected author used for reference would be difficult to establish.

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8. Evans, Morris and Hall, L. F. Crops Project Record Book for use in Vocational Agriculture Courses.

Ditto Live-Stock Project Record Book...ditto

However an analysis of specimens of each fail to disclose any additional mathematical skills not included in the results of research thus far. Exhibits V-VII show the presence of these skills in a reference textbook, a local outline of the crops course, and a local outline of the livestock course, respectively. Practically all skills are represented in each source but no additional skills. Exhibit VIII enumerates the skills requisite to efficient work in a course in vocational agriculture as revealed by this study.

Exhibit I

Time emphasis on phases of farm mechanics (estimates) (after Pollom.)

Phase of mechanics	No. of job types listed	Percent of shop time
Farm Carpentry	24	34
Gas Engine, Auto, Tractor Mechanics	8	11
Farm Machinery Adjustment, Repair	12	10.7
Cold Ironwork	6	4.8
Soldering	5	4.7
Blacksmithing	7	12.6
Harness Repair	8	5.4
Fitting, Repairing Hand Tools	5	4.7
Concrete Work	16	5.8
Farm Plumbing	18	4.2
Power Transmission	11	3.1
Mechanical Advantage Devices	6	3.2
Babbiting	-	2
Rope Work	8	3.5

Exhibit II

Mathematics processes and topics in selected farm shop activities

Activity	Processes	Topics
Carpentry		
Laying off bldg. site	Addition	Linear measure
Figuring bills of mat'l	Multiplication	Board measure
Reading plans		Ratio
Drawing plans		Scale drawing
Cutting rafters	Square root	Pythagorean theorem
Flooring, roofing		Areas
Remodeling bldgs.		Estimating
Gas engine mechanics		
Transmission	Ratio	Gears
Ignition, lights		Electrical units
Farm machinery		
Multiple hitches	Ratio	Levers, force diagram
Cold Ironwork		
Use of taps and dies	Ratio	Pitch, diameters
Blacksmithing		
Tempering		Temperatures
Concrete construction		
Building forms		Board measure
Measuring mixtures	Multiplication	Volumes
Mixing	Ratio	
Farm Plumbing		
Measuring, cutting pipe		Linear measure
Threading, fittings,	Ratio	Pitch, diameters
Pumps, pumpjacks	Ratio	Leverage, gears
Power transmission		
Line shaft, belting, etc		
Bearings, lubricants	Percentage	Friction, efficiency
Mechanical advantage devices		
Block and tackle	Equations	Pulleys
Levers	Formulae	Leverage
Jackscrew	" "	Screws
Inclines	" "	Inclined plane
Windlass	" "	Wheel-axle

Exhibit III

Mathematics skills in crops project records

Heading	Mathematics processes
Record of Visits	dates, time units.
Description of Project	time, land measures.
Crop Operations on Farm	dates, acres, yield, money
Project Inventory	dates, measures, depreciation, money, addition, subtraction.
Project Agreement	dates, apportionment: fractions, percentage.
Project Plot	linear measure, ratio, scale-drawing, areas, land measures, multiplication, division.
Problem Outline	
Working Plan	
Diary	dates, time units.
Record: man labor, horse work, equipment	dates, time, multiplication, addition, money, decimals.
Products Sold or Used on Farm	dates, measures, money, decimals, multiplication, subtraction, addition.
Cash Expenses	dates, addition, measures.
Expenses: Not Cash	percentage, interest, taxes, time, multiplication, addition.
Summary of Project	addition, subtraction, profit and loss.
Analysis of Project	measures: land, dry, areas, division, profit and loss.

Exhibit IV

Mathematics skills in live stock project records

Heading	Mathematics skills
Record of Visits	dates, time units
Description of Project	time, land measures
Live Stock Operations	dates,
Inventories	dates, measures, depreciation money, addition, subtraction
Project Agreement	dates, apportionment: fractions, percentage
Diary	dates, time units
Record: man labor, horse work, equipment	dates, time, multiplication, addition, money, decimals
Products Sold or Used on Farm	dates, measures, money, decimals, multiplication, subtraction, addition
Feed Cost Record	dates, measures, money, division, addition
Cash Expenses	dates, addition, measures
Expenses: Not Cash	percentage, interest, time, multiplication, addition
Summary of Project	addition, subtraction, profit and loss
Feed Summary and Cost	measures, addition, division
Weight Record	dates, weight units, time units, addition, division
Individual production record: cows	time, percentage, multiplication, addition, money, division, subtraction

Exhibit V

Mathematics Skills Found in a Standard Vocational Agriculture Reference Book*

Page	Skill	Vocational Topic
2	percent, decimals	composition of eggs mineral content of eggs
3	metric units: weight	
12	British units: wt.	per capita consumption
15	graph: broken line	population: chickens: eggs
17	money	value farm products
19	maps	areas of production
20	circle (graph)	areas of production
29	dates	Early distribution
56	temperature	Life of chicken
87	ratio	Mendelism
174	heat units	embryonic development
210	time units	incubation practices
233	areas	brooders
242	board measure	poultry yard
248	market report	(broilers)
258	volumes	ventilation
261	multiplication, division, subtraction	formula (heat units)
269	scale drawing, fractions	Laying house
273	Pythagorean theorem	squaring house

*Jull--Poultry Husbandry

Exhibit V (con't)

349	mixtures	rations
363	formula	nutritive ratio
405	Apothecaries' weight	disease control
436	liquid measure	disease control
451	parcel post	transportation
474	freight, express	transportation
495	land units	by products: fertilizer
528	depreciation	economics
538	algebraic equation	feed costs
557	profit and loss	records
558	inventory, interest	records
562	addition, averaging	records
Chapter headings	Roman Numerals	

Exhibit VI

Mathematics Skills Found in a Local Course Outline for Crops*

Skill	Vocational Enterprise	
Marketing, yields	General	No. 1
Percentage, averages	General	4
Land measure, time units, money, power units	General	6
Profit-loss, money, apportionment, interest	General	8
Borrowing money	General	9
Apportionment: percentage, fractions	General	10
Time units, linear measure	General	11
Dry measure, money, percent	Wheat	1
Time, yield, volumes	Corn-Sorg.	1
Linear units, percentage	General	12
Percentage	Wheat	2
Money	Wheat	3
Time, ratio, percentage, linear measure	Wheat	4

*Prepared by Carl Heinrich, Burlington and L. E. Croy, Havensville in summer school at Manhattan. These men were both teachers in service at the time.

Exhibit VI (con't)

Dry measure	Corn-Sorg.	2
Money, power units, fuel, machines	General	12
Money, time, yield, interest, apportionment	General	25
Money, time, power units	Corn-Sorg.	3
Volumes	Corn-Sorg.	4
Weight units, land units, ratio, time	Soils	2
Linear units, areas	Garden	1
Temperature, percentage	Soils	5
Weights, decimals, ratio percentage	General	18, 19
Percentage	General	20
Money, measures, volumes	General	21
Marketing, Graphing	General	22
Board measure, Linear units, area, weights	Garden	1
Time	Hort.	1
Money	Leg.	1
Ratio	Leg.	1
Scale Drawing	Hort.	1
Ratio	Pasture Mgmt.	1
Money, Profit-Loss	General	2
Records	General	1

Exhibit VII

Mathematics Skill Found in a Local Course Outline for Animal Husbandry*

Skill	Vocational Enterprise
Averages, Percentages	General
Time, Transportation	Swine
Money, Percentage	Poultry
Board Measure, Linear Measure Areas, Money, Ratio, Scale Drawing	Poultry
Percentage, Weights, Liquid measure	Dairy
Time	Dairy
Rations	Swine
Rations, Nutritive Ratio	Poultry
Mixtures, Money, Measures	Poultry
Estimating Temperature	Dairy
Money, Apportionment, Loans, Interest	General
Weight units, money	General
Percentage	General
Money, ratio, percentage	General
Marketing, money	Dairy
Temperature	Poultry

*Prepared by Carl Henrich, Burlington and L. E. Croy, Havensville in summer school at Manhattan. These men were both teachers in service at the time.

Exhibit VII (cont)

Rations	Beef, Dairy
Percentage, Weights, Volumes	Dairy
Weights, Money	Swine
Ratio, Time, Weight	Swine
Marketing, Measures	Poultry
Graphs	General
Weights	General
Percentage	General
Ratio	Poultry
Liquid Measure	Dairy
Temperature, Ratio, Money	Poultry
Money, Ratio	Poultry
Percentage	Sheep
Temperature, Money	Poultry

Exhibit VIII

Comprehensive, unclassified list of mathematical concepts involved in vocational courses

addition
algebraic equation
Apothecaries Wt.
apportionment
areas
arithmetic average
board measure
budgets
circles
co-operatives
dates
decimals
depreciation
discount
division
electrical units
express
formulas (algebraic)
fractions
freight
graphs
heat units
insurance
interest
inventory
land units
linear measure
liquid measure
market (reports)
Mech. adv. devices
Metric units
mixtures
money
multiplication
parcel post
percentage
power units
profit-loss
Pythagorean Theorem
ratio
Roman numerals
scale drawing
square root
subtraction
taxes
temperature
time units
volumes
weight

CHAPTER III

VOCATIONAL HOME MAKING

Under the present set-up courses in vocational home making are offered to girls fourteen years of age and over. They are taught by specially trained teachers who are approved and paid in part by federal government agencies.[9] Teachers are employed for the academic year, a minimum of thirty-six weeks. A minimum of two years work is offered in each high school. The minimum course includes foods and home management, clothing and textiles, with home project work the first year; foods and nutrition, health and home nursing, child care and development, and advanced work in clothing and textiles the second year. Of course the home project work continues through the second year. Half the school day (continuous) is devoted to the vocational subjects, the other half to academic or non-vocational subjects.[10]

As in the agriculture projects so also in the home making projects the girls are required to keep a project record book.[11] In contrast to the agriculture projects, however, there is a minimum of mathematics required. This is due in the main to the

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9. Plans for Vocational Education in Kansas. Part V, p. 32 ff.

10. Ibid.

11. Thompson, Hazel E. Project Record for Vocational Home Making. Topeka. Kansas State Board for Vocational Education, 1934. 16p.

absence of the profit motive in housekeeping. The closest parallel to be found in the two classes of projects is in budgeting of time and economy in expenditures. In the case of home making the mathematics requirements concentrate in the classroom and laboratory studies.

A PREVIOUS STUDY

In 1925 McCluskey[12] made an analysis of the mathematics involved in home economics. Her study differs from the problem in this research in that she did not give particular attention to the work in home economics at the high school level. But critical examination of her thesis shows peculiar appropriateness to vocational homemaking. In her introduction she states

> ...It is the purpose of this study to discover (1) types of mathematics that are used by the woman in the home,---the types she uses in cooking, in canning and preserving, in household finances, in home decorating, in laundering, in the care of children, and in general reading, and (2) the types that are used by the student of home economics.....

The writer wishes to avoid the investment of time in unnecessary tabulation of minute detail if the validity of the McCluskey study can be established in the field of vocational home making. Accordingly a comparison was drawn between the purposes of vocational home making and those of the McCluskey study. In Exhibit IX are the results of this comparison together with study topics for vocational home making

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12. McCluskey, Mary Ola. An Analysis of the Mathematics Involved in Home Economics. Chicago. University of Chicago. Master's Thesis. 1925. 77 p ms.

taken from a suggested outline by Miss Thompson[13] and selected individual projects taken from a list in the Project Record Book for Vocational Home Making.[14] The parallel is closer than might have been expected.

To represent the work of home economics students McCluskey analyzed five technical reference books; to represent the housewife as well as the student the analysis was extended to include six general reference books and four magazines in the field of home economics. In Exhibit X will be found the parallel between the McCluskey references and references now in use in Kansas vocational home making departments of high schools. Not only is there an evident parallel of source materials but also more than half the reference books used by McCluskey are to be found in the F.H.K.S.C. library, as are all the magazines. Two of the same books and three of the same authors are on both lists of Exhibit X and all the magazines are on both lists. To make sure about the magazines the writer compared the circulation figures with those of the most popular magazines of the day, in the same and in other fields.[15] All these comparisons contribute to the high validity of the McClusky research for interpretation in the present investigation.

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13. Thompson, Hazel E. A Suggested Arrangement of Units for Vocational Home Making All Day Schools. Topeka. Kansas State Board for Vocational Education, 1935. 12p.

14. Thompson. Project Record Book (ibid)

15. Only one magazine known to the writer, The Saturday Evening Post, has circulation figures exceeding those of magazines used by McCluskey. No magazine, in the same field known to the writer, has circulation figures exceeding half the magazines used by McCluskey.

With the above justification, McCluskey conclusions are quoted

I. The following topics should occupy an important place in the curriculum:

1. An understanding of Arabic numerals (to eleven digits)
2. Simple and mixed fractions (mixed numbers?) (denominators, chiefly first ten digits)
3. Percentage (Case I)
4. Decimal fractions (to five decimal places)
5. Units of time
6. Liquid measure
7. Linear measure (omitting the rod)
8. The Metric System
9. Electrical Units
10. Temperature scales
11. Dry measure
12. Avoirdupois weight
13. The four fundamental operations.

II. The following topics do not appear so frequently..... A knowledge of some of them can be gained incidentally:

1. Dates
2. Roman Numerals
3. Square measure
4. Cubic measure
5. Apothecaries' weight
6. Ratio
7. Graphs
8. Algebraic operations
9. Square root

The writer adheres to the principle that all topics which are needed by students should be placed in the curriculum, not left to incidental learning. The McCluskey study was painstakingly done and should be utilized in a curriculum making project. The writer has elected to accept her findings as a guide in the selection of mathematical content and the framing of problem exercises; e.g. Arabic numbers need seldom exceed three digits, decimals--two places, fractions--one digit denominators, etc.

Exhibit IX

Diagram of Vocational Home Making Aims and Purposes

A.	B.	C.	D.
Cooking	Foods, Cookery	Planning, preparing, serving breakfast, supper.	V. Food study
Canning, preserving		How to preserve food for future use	
Household hygiene	Home Nursing	Contagious diseases, their control	VI. Personal improvement and health
Household finances	Home Management.	The family income and its expenditures	I. Home Management and family relationships.
Home decorating	Home planning	How to plan and furnish our home	III. Home improvement
Laundering	Laundering (p.34)	How to launder our clothing	IV. Clothing
Care of children	Care of children	Caring for the infant and preschool child	II. Child care and development
General reading		Providing for advancement and higher life needs.	

LEGEND:

A. McCluskey's stated purposes of her study.

B. Officially stated subjects in home making.

C. Selected units of study in home making.

D. Classification of home making projects.

Exhibit X

Comparison of sources of information.

McCluskey's sources of data	Approved textbooks and references for vocational home making.*
Taber-Business of the household.#	Andrews-Exonomics of the household. (p. 201)
McCullum-Newer knowledge of nutrition.	Cooper: Barber-Nutrition in health and disease (p. 197)
Balderson-Laundering.#	Woolman-Clothing: choice, care, cost. (p. 198)
Keene-Mechanics of the household.	Allen-Mechanical devices in the home. (p. 200)
Buchanan-Household bacteriology.#	
Izor-Costume design and home planning.#	Izor-Costume design and home planning. (p. 198)
Patton-Home and School sewing.	Cook-Essentials of sewing. (p. 198)
Powell-Preserving and canning.	Malcomb-Successful canning and preserving. (p.197)
Frederick-New Housekeeping	Frederick-Efficient housekeeping. (p. 200)
Holt-Care and feeding of children.#	Turner-Home nursing and child care. (p. 201)
Donham-Spending the family income.#	Donham-Spending the family income. (p. 200)
Good Housekeeping	Good Housekeeping
House Beautiful	House Beautiful
Woman's Home Companion	Woman's Home Companion
Ladies Home Journal	Ladies Home Journal

#Contained in F.H.K.S.C. Library.

*Markham-(State of Kansas) Course of Study for High Schools, Pt.IX-Home Economics.

Exhibit XI

Comparative circulation of certain magazines (1929)

Title of magazine	circulation
Good Housekeeping	1,642,368
House Beautiful	95,147
Ladies Home Journal	2,531,287
Woman's Home Companion	2,327,527
House and Garden	135,872
Delineator	1,511,573
McCall's	2,300,387
American Magazine	2,145,718
Saturday Evening Post	2,902,093
True Story Magazine	2,167,051

CHAPTER IV

CONCLUSIONS

From this study it is evident that students of vocational agriculture and vocational home making have a definite need and daily use for mathematics. The need is chiefly for arithmetic with certain concepts from algebra and geometry. A course of study to meet their needs should include addition, algebraic equations, areas, board measure, budgeting, circles, decimals, division, electrical units, fractions, graphs, heat units, insurance, interest, land measures, marketing, mechanical advantage devices, the metric system, multiplication, percentage, profit and loss, ratio, scale drawing, square root, subtraction, taxes, temperature scales, volumes.

The requirements of the two courses are not co-incident so that boys and girls might be better taught in separate groups but the topics are co-incident for at least eighty percent of the requirements and a course for coeducational instruction in mathematics seems practical.

Such a course in mathematics should be framed in compliance with the following principles:

1. Psychological arrangement of topics is preferable to logical arrangement unless the two are identical.

2. Problem material should be drawn from rural life situations almost exclusively.

3. Provision should be made for individual differences.

4. Chief stress should be laid upon the four fundamental operations with diversity of topics from the field of vocational science.

5. Ample drill material should be provided to serve remedial purposes.

6. Topics should be sufficiently limited to permit frequent review and adequate testing programs.

7. Wherever possible every process will employ denominate numbers.

8. Arabic numerals shall not be amphasized beyond nine digits; chief stress shall be laid upon numbers of less than five digits.

9. Fractions with denominators of a single digit shall receive greatest emphasis.

10. Decimals shall not be stressed beyond four places.

11. Percentage shall be given importance second to none.

12. Money shall be taught to the extent of 5-place dollars, and cents.

13. Electrical units of power shall be given attention equal to that of all other units combined.

14. Ratio shall be given space comparable to percentage.

CHAPTER V

AIMS AND OBJECTIVES

This course in mathematics for students of vocational agriculture and vocational home making has been prepared in the light of the following aims and objectives:

1. To SUPPLEMENT the MATHEMATICS TAUGHT in the ELEMENTARY SCHOOL by

   a. Automatizing Fundamental Processes

   b. Diagnostic and Remedial Work

The writer has tried in every way to motivate the course legitimately and within the bounds of good pedagogy. However drill work is inescapable and assignments have been given over to work purely of that type. It is recommended that some standard diagnostic test (see appendix) be administered early in the course and remedial work should follow immediately.

2. To STIMULATE PUPIL INTEREST in MATHEMATICS through use of PROBLEMS of VOCATIONAL NATURE.

One of the greatest advantages claimed for this course is the case of motivation because almost all problems are from real life rural situations. Other types of problems have been included only frequently enough to break the monotony.

3. To offer additional (REMEDIAL) to the process of MATURATION of the REASONING FACULTY.

Recognized failure of pupils to master reasoning problems possibly is due to the absence of familiar elements in problem content. It is hoped that performance on reasoning problems in this course will be higher than it has been in elementary school courses and the reasoning faculty artificially stimulated.

4. To offer ALGEBRAIC and GEOMETRIC TOPICS of greatest value to pupils of VOCATIONAL COURSES

PART II

CHAPTER V

AIMS AND OBJECTIVES

This course in mathematics for students of vocational agriculture and vocational home making has been prepared in the light of the following aims and objectives:

1. To SUPPLEMENT the MATHEMATICS TEACHING of the ELEMENTARY SCHOOL by

   a. Automatizing Fundamental Processes

   b. Diagnostic and Remedial Work

   The writer has tried in every way to motivate the course legitimately and within the bounds of good pedagogy. However drill work is inescapable and assignments have been given over to work purely of that type. It is recommended that some standard diagnostic test (see appendix) be administered early in the course and remedial work should follow immediately.

2. To STIMULATE PUPIL INTEREST in MATHEMATICS through use of EXERCISES of VOCATIONAL NATURE.

   One of the greatest advantages claimed for this course is the ease of motivation because almost all problems are from real life rural situations. Other types of problems have been included only frequently enough to break the monotony.

3. To offer additional STIMULATION to the process of MATURATION of the REASONING FUNCTION.

   Recognized failure of pupils to master reasoning problems possibly is due to the absence of familiar elements in problem content. It is hoped that performance on reasoning problems in this course will be higher than it has been in elementary school courses and the reasoning function constantly stimulated.

4. To offer ALGEBRAIC and GEOMETRIC TOOLS of greatest value to pupils of VOCATIONAL COURSES

It is presumed that few students who pursue this course will ever be enrolled in either algebra or geometry courses of unit credit. Only those concepts indispensable to efficient participation in vocational courses have been included here.

5. To CORRELATE MATHEMATICS with GENERAL EDUCATIONAL AIMS by use of thought questions soliciting other than quantitative answers.

Some of these aims are thrift, precision, neatness, punctuality, courtesy, appreciations.

6. To achieve these aims with a MINIMUM of ENCROACHMENT upon the content of the VOCATIONAL SCIENCE

Care has been taken to offer no information as fact which might in any way conflict with practices to be taught in the vocational courses. This is perhaps the most delicate problem in constructing such a course.

Specific Aims

The writer has not stated specific aims for individual lessons. Such practice in the past has been little more than to prefix useless and meaningless infinitives to the topics of the lesson or unit. Specific objectives are evident to any efficient classroom teacher.

CHAPTER VI

SUGGESTIONS TO TEACHERS

In a chapter of suggestions the writer is tempted to reiterate the aims and objectives. The teacher needs always to remember that this course is for students entering specified vocational courses. The content, method, techniques, activities should combine to meet the demands made upon this course by vocational requirements. It is presumed that this course will be offered only in high schools where one or both vocational courses are tuahgt. The alert teacher of this course will be a careful observer of the vocational departments and sensitive to local situations. Conditions prevalent there should supercede all other suggestions, even those which follow. Where half time vocational departments obtain the vocational teacher is the logical one to teach this course.

BOOKS. No textbook is known to exist which serves in a capacity such as the purpose set for this course. The outline has not been designed to follow any textbook. Rather, the writer hopes to produce a textbook which will meet this special purpose as soon as ample research for that project has been made. Appendix C contains a list of references which includes textbooks, science books, authors of mathematical recreations, books on psychology and method.

ORDER OF TOPICS. Psychological order should prevail. Budgeting has been selected as the first topic because student spending is prominent at the beginning of the school term. The topic of Taxes was arranged

to fall about Dec. 15 when talk of taxes and tax paying are of community interest. Arithmetic Average has been chosen as the topic to introduce Division. Note was made that Lesson D might well be used to introduce Unit VIII. If the community suffers from a disastrous fire, tornado, or flood teach Unit XVIII at once, or review it if already taught.

In selecting sequence of topics "strike when the iron is hot". Inadequacies in mastery of other skills will determine the relative emphasis and drill to be given those skills--note the need for their study and give such emphasis and drill as the need warrants. Such needs are the justification for this course; lacking such needs, do not offer the course just to allow unit credit.

DIAGNOSTIC AND REMEDIAL WORK. Test as early as possible and start remedial work at once. Diagnostic tests are listed in Appendix C. The research which led to the development of this course disclosed fair achievement in arithmetic reasoning by elementary school pupils but surprising deficiencies in ordinary computation. Discover and correct those deficiencies.

INDIVIDUAL DIFFERENCES. Where greater differences occur than are cared for by exercises for "Second Milers" use mathematical recreations. Encourage some amateur research by investigating available records of completed projects in the vocational departments. Ask the vocational instructors for estimates on projects in progress which you may audit. Other suggestions probably will be made at the same time. If some appetites still are ungratified feed them worth while material outside this narrow field, possibly regular algebra, or geometry, according to pupil interests.

TIME ALLOTMENTS. Several units will doubtless require more time than is indicated by the number of outlined lessons. Among such units are VI, XI, XII, XIV, XX, XXI, XXIV, XXX. It is to be remembered that these topics should not be wholly new to the students. The topics are common to almost all textbooks of high school arithmetic or algebra. Utilize other books and stay on a topic until reasonable mastery is attained.

UNIT I. The publication of government unit budgets should make available a wealth of material for this unit. Perhaps two weeks should be spent on this unit.

UNIT II. Lesson E may require more than a day. Spend enough time that no student leaves answers in other than their simplest from. (e.g. 89' 14", 10 lb. 20 oz.)

UNIT V. If Lesson B requires more than a day, use more. Make scale drawings for a week if students are interested and drawings are put to use.

UNIT X. Use thermometers and if necessary perform an experiment to insure mastery of the unit.

UNIT XII. Do not go to the experimental stage in this unit. Teach the formulas and leave it to the vocational science to make the application.

UNITS XVI, XVII. Use a company representative if one is available but don't let them have the class at the beginning of the hour.

UNITS XXI, XXII. Don't leave these units without thorough mastery of the last lesson in each. They are ultra-important.

UNIT XXIV. Don't expect the mastery of this unit as one might demand in an algebra class.

CHAPTER VII

OUTINE OF CONTENT

Unit I BUDGETING

*Lesson A. Allowances (personal)

Lesson B. Organization Budgets: School District Township

Lesson C. Family Budgets: Construction

Lesson D. Family Budgets: Application

Lesson E. Federal Budget

Unit II ADDITION

Lesson A. Simple Combinations: 100 addition facts#

Lesson B. Addition by Grouping: two-digit numbers

Lesson C. Addition by Sums of Groups: checking (machines)

Lesson D. Addition on the Horizontal: records, extensions

Lesson E. Addition of Denominate Numbers: linear measure weights, etc.

Unit III DIVISION

Lesson A. Arithmetic Average: grades, attendance, etc.

Lesson B. Short Division: include two-digit divisors

Lesson C. Long Division: trial divisors

Lesson D. Division Involving Denominate Numbers

Lesson E. Short Methods of Division

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*See Chapter VIII, Lesson 1.

#See Appendix

Unit IV MULTIPLICATION

Lesson A. Drill on Tables: include 15, 16, 18, 20, 25.

Lesson B. Multiplication by Aliquot Parts

Lesson C. General Multiplication and Short Methods

Lesson D. Multiplication Involving Denominate Numbers

Unit V SCALE DRAWING

*Lesson A. Maps: road maps, local maps

Lesson B. Plots: buildings, gardens, fields, farms

Lesson C. The Box Scale

Unit VI FRACTIONS

Lesson A. L. C. D. and Equivalent Fractions

Lesson B. Changing Mixed Numbers to Improper Fractions

Lesson C. Changing Decimals to Common Fractions

Lesson D. Addition and Subtraction of Common Fractions

Lesson E. Multiplication and Division: Cancellation

Lesson F. Apportionment: Work problems, etc.

Lesson G. Complex Fractions.

Unit VII DECIMALS

Lesson A. Reading Decimals: at least to five places

Lesson B. Addition and Subtraction of Decimals

Lesson C. Multiplication by Decimals: also by 10, 100

Lesson D. Division by Decimals: also by 10, 100, etc.

Lesson E. Decimals and Roman Numerals

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*See Chapter VIII, Lesson II

Lesson F. Decimals and the Metric System

Lesson G. Decimals and the Metric System continued.

Unit VIII SUBTRACTION

Lesson A. Methods of Subtraction: facts, drill

Lesson B. Subtraction Involving Borrowing

Lesson C. Subtraction of Denominate Numbers

Lesson D. Money and Making Change[1]

Unit IX PROFIT AND LOSS

Lesson A. Inventories: household and farm only

Lesson B. Overhead Expense: personal, household, farm

Lesson C. Depreciation: houses, etc; implements, etc.

Lesson D. Net Valuation:

Lesson E. Profit (or loss)

Unit X TEMPERATURE SCALES

Lesson A. Fahrenheit Scale: important readings

Lesson B. Centigrade Scale: converting each to the other

Unit XI ALGEBRA

Lesson A. The Formula: interrelation of parts

Lesson B. Formulae of Arithmetic

Lesson C. Formulae of Science

Lesson D. The Equation: its laws

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1. Lesson D might well be the first lesson of Unit VIII.

Lesson E. Linear Equations:

Lesson F. Fractional Equations:

Unit XII MECHANICAL ADVANTAGE DEVICES

Lesson A. Levers

Lesson B. Incline

Lesson C. Pulleys

Lesson D. Windlass

Lesson E. Gears

Lesson F. Work Principle: Efficiency

Lesson G. Power Problems

Unit XIII HEAT

Lesson A. Units of Heat Energy: B.t.u., calorie

Lesson B. Caloric Values: foods, fuels

Lesson C. Heat of Fusion and Vaporization

Unit XIV ELECTRICITY

Lesson A. Electrical Units: formulae

Lesson B. Electric Meters: charges for electricity

Lesson C. Conversion of Electricity

Unit XV TAXES

*Lesson A. Valuation, levies: real and personal property

Lesson B. Tax Apportionments: distribution

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*See Chapter VIII, Lesson 3

Lesson C. Other Tax Forms: sales tax--gasoline, etc.

Lesson D. Other Tax Forms: income tax, severance tax

Unit XVI INSURANCE: PERSONAL

Lesson A. Cost Factors

Lesson B. Companies

Lesson C. Contract Types

Lesson D. Policy Privileges

Unit XVII INSURANCE: PROPERTY

Lesson A. Cost Factors

Lesson B. Companies

Lesson C. Contracts: Hazards

Lesson D. Adjustments

Unit XVIII INTEREST

Lesson A. Simple Interest: time given

Lesson B. Simple Interest: computing

Lesson C. Bank Discount

Lesson D. Installment Buying

Lesson E. Short Methods: Interest tables*

Lesson F. Building and Loan, Insurance

Unit XIX PERCENTAGE

Lesson A. The Symbol: affixing, removal

Lesson B. Case I

Lesson C. Cases II, III

Lesson D. Miscellaneous Applied Problems (I, II, III)

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*See Chapter VIII, Lesson 4

Lesson E. Trade Discounts: single

Lesson F. Trade Discounts: successive

Lesson G. Commissions

Unit XX RATIO

**Lesson A. Ratio and Division

Lesson B. The Proportion

Lesson C. Mixtures: recipes, concrete

Lesson D. Rations

Lesson E. Ratio: Percentage: Decimals

Unit XXI AREAS

Lesson A. Units of Area

Lesson B. Area of Square, Rectangle, Parallelogram

Lesson C. Area of Triangle, Trapezoid

Lesson D. Area of Circle

*Lesson E. Variation in Areas

Unit XXII VOLUMES

Lesson A. Units of Volume

Lesson B. Volume of Rectangular Solid

Lesson C. Volume of Cylinder

Lesson D. Variation in Volumes

Unit XXIII CIRCLES

Lesson A. Parts of Circle: radius, diameter, circumference

**See Chapter VIII, Lesson 5

*See Chapter VIII, Lesson 6

Lesson B. The Protractor: angle degrees, circular degrees

Lesson C. Sectors: graphs and percent

Unit XXIV GRAPHS

**Lesson A. Co-ordinate Axes: location of points

Lesson B. Line Graphs: broken, curved

Lesson C. Other graphs: circle, bar, et al.

Unit XXV MARKETING

Lesson A. Market Reports

Lesson B. Transportation: private

Lesson C. Transportation: parcel post, freight, etc.

Lesson D. Dry Measure

Lesson E. Liquid Measure

Lesson F. Farm Produce: cream, eggs

Lesson G. Live Stock, Poultry

Unit XXVI CO-OPERATIVES

Lesson A. Organization

Lesson B. Capitalization

Lesson C. Dividends

Unit XXVII LAND

Lesson A. Measuring Land: units

Lesson B. Titles, Descriptions

Lesson C. Value Factors

Lesson D. The Survey

**See Chapter VIII, Lesson 7

Unit XXVIII BOARD MEASURE

*Lesson A. Formulae for Board Measure

Lesson B. Figuring Dimension Lumber

Lesson C. Figuring Finish Lumber

Lesson D. Methods of Billing Lumber

Lesson E. Estimating Small Projects

Lesson F. Lumber Rates Other Than Board Measure

Unit XXIX SQUARE ROOT

Lesson A. Pythagorean Theorem

Lesson B. Formula Method of Square Root

Lesson C. Use of Square Root Tables

Unit XXX METRIC SYSTEM

Lesson A. Units of Volume

Lesson B. Linear Units

Lesson C. Areas

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*See Chapter VIII, Lesson 8.

CHAPTER VIII

ILLUSTRATIVE LESSON PRESENTATIONS

Lesson 1. ALLOWANCES

Lesson 2. SCALE DRAWINGS

Lesson 3. TAXES: Valuation, Levies

Lesson 4. INSTALLMENT BUYING

Lesson 5. RATIO and DIVISION

Lesson 6. VARIATION in AREAS

Lesson 7. GRAPHING: Co-ordinate Axes

Lesson 8. FORMULAE for BOARD MEASURE

Lesson 1

ALLOWANCES

Thrift is one of the greatest virtues. It requires that one know how to spend money wisely as well as how to earn money.

Frequently parents encourage thrift by permitting their children to have a regular amount of money to spend and no more. Such children are said to have an allowance. How much money do you think a six-year-old boy should have to spend each week?

Some parents are more generous than others in granting allowances. List some conditions which in your opinion should affect the amount of a weekly allowance. What are some things a freshman boy or girl should buy with an allowance?

Problems

1. George was given a choice of $1.25 weekly allowance or $5 per calendar month. Which was the more generous offer? Would you prefer a weekly or monthly allowance? Why?
2. Marie planned her allowance so that a percent of it should be used for each of several items. Her plan was--Clothing 40%, Books, etc. 25%, Recreation 25%, Savings 10%. How much did she save from each dollar? How much went to each of the other items?
3. Catherine had a monthly allowance of three dollars. By following Marie's plan how much could she spend each year for clothing? Do you suppose she paid for all her clothing?

4. Bill received a weekly allowance of fifty cents, beginning Sept. 1. On Sept. 25 he wanted to buy an activity ticket costing 75 cents. If he followed Marie's plan how much did he lack? (four weeks) What should he do?

5. Jim bought a $40 bicycle to ride to school. By following Marie's plan how long did it require him to save that amount from a $10 monthly allowance?

6. Immediately after the opening of school Gladys had spent all her money for new clothing, school supplies, sporting goods; and her savings were in the bank, not subject to withdrawal. If she borrowed fifty cents from her mother that she might attend a circus how soon could she repay the loan from a one-dollar weekly allowance? Do you think her mother should lend her the money?

7. With Marie's plan what allowance would permit one to give half one's savings to charity and still save ten cents per week?

8. Considering everything how much do you think your allowance should be? Plan it more in detail than Marie's. Have at least five items.

9. Find the amount per year you would have for each item of your plan.

"Second Milers"

Make out a detailed budget of at least eight items and put it into operation for a period of six weeks. Keep an accurate account of your expenses.

If you have no allowance submit your plan to your parents as evidence of the advisability of granting you an allowance.

Lesson 2

SCALE DRAWING: Maps

If you were planning a trip to some convention, judging contest or vacation outing one of the preparations you should make is a choice of route, probable stopovers, and time schedules. A map is a very great help in such plans. A map is a sort of picture of geographic locations. Distance and direction are the two important facts to be obtained from maps.

A map of Kansas might be as large as a commercial sign board near a highway, as small as a postage stamp or of a size between those extremes. Maps are commonly the size of the page of a book or a wall chart. To show true distances such maps must be drawn to scale, i. e. a small distance on the map must represent a larger distance between geographic points, e.g. one inch may represent forty miles. On such a map two towns ten miles apart would be shown by dots one-fourth inch apart.

A map of your county or township may also be the size of a page in a book. The larger the map, or the smaller the area represented, the greater is the scale. Every map should include an explanation of the scale used. Usually that scale is shown in one corner of the page or chart.

Problems

1. Kansas is said to be approximately 400 miles long and 200 miles wide.

With a scale of 40 miles to one inch how far apart should the east and west boundaries? the north and south boundaries? Would that scale be practical for a state map?

2. If the scale is 40 mi.= 1 in, how far apart are two cities shown by dots $2\frac{1}{2}$ inches apart?

3. What distance should separate dots which respresent cities 180 miles apart? (Use scale of Ex. 2)

4. What is the length of a county if its scale is 1 mi.=1/8 in. and its map is 4 inches long?

5. Using the scale of Ex. 4 what distance on the map should separate towns 20 miles apart?

6. A congressional township is said to be six miles square. Using the scale of Ex. 4 what would be the dimensions of a township map?

7. Bill rides 12 miles to school. What scale (Ex. 1, Ex. 4,) would better show the distance from Bill's home to school?

8. If the distance across the U.S. from Atlantic to Pacific is3000 miles, what would be the length of a U.S. map using the scale of Ex. 1?

9. On a scale of 12 miles to one inch what distance is represented by $2\frac{1}{2}$ in? 6 in? $1\frac{1}{4}$ in? $7\frac{1}{8}$ in? 12in?

10. A man lives 140 miles from the Kansas City market. What is the distance on the map? (Scale 80 mi.=1 in.)

11. A school district map shows a bus route totaling 2 3/4 in. How long is the route if the map has the same scale as Ex. 4?

12. On a township map John figures his home to be 3/4 in. from the nearest bend in a creek. What is the actual distance if the scale is 1 mi.=1/8 in?

"Second Milers"

A map is most useful when drawn to the largest possible scale because details can be shown. Determine the scale for the largest map you can draw on ordinary $8\frac{1}{2}$ x 11 note paper of each of the following: (a) State of Kansas, (b) your own county, (c) your own township, (d) a congressional township, (e) your own farm home or one with which you are familiar.

Lesson 3

TAXES: VALUATION, LEVIES

Government expenses, schools and some other enterprises are maintained at public expense. The contribution which a citizen makes to these public funds is known as a tax. The oldest and most universal tax in the United States is on land and buildings, real estate. The rate of taxation is a matter of percentage; but the rate is frequently less than 1% so a smaller unit called a mill is used--a mill is equivalent to one-tenth of one per cent.

In the spring an official known as the assessor visits each citizen and compiles a list of property owned with its value. If Mr. A. owns a quarter section of land with improvements the official might list it as worth $6000, that would be its valuation. Again Mr. A probably owns some live stock, machinery, and harvested crops; these are known as personal property; let us value these at $4000. Mr. A's total valuation of real and personal property is $10,000. If the tax rate in his school district is5 mills, Mr. A will be required to contribute $50 toward the support of his school.

More recently we have had other forms of taxes, including income tax, special sales taxes (e.g. gasoline, tobacco) and in some states a general sales tax. Some of these will be studied in later lessons.

Each unit of government must estimate its expenses in advance, i. e. the officials must prepare a budget. The budget total is gener-

ally known as the amount. The quotient of this amount divided by the valuation (A/V) of the taxing unit gives the tax rate. Thus if the school which Mr. A supports needs $5000 for the year and the total valuation of all property in the district is $1,000,000 then the quotient (A/V) is .005 and the tax rate is 5 mills. This tax rate is also known as a levy.

Problems

1. If Mr. A pays a school levy of 5 mills, a township levy of 1.5 mills, a county levy of 2.25 mills and a state levy of 1.25 mills what is his total tax rate?

2. When Mr. A has a valuation of $10,000 and the tax rate is 12 mills how much tax must he pay? How much should he pay under the rate of Ex. 1?

3. Miss X, a teacher, has only personal property, a car, valued at $400. How much tax must she pay when the rate is 12 mills?

4. A rural school has a budget calling for $1200. If the valuation of the district is $150,000 what levy must be made for school support? (Such a levy is considered excessive.)

5. The property of a certain township is valued at three million dollars. With a levy of 1.5 mills what amount of money will be raised for township expenses?

6. If your father paid $150 taxes on a valuation of $12,500, what is the tax rate in your community?

7. If Beth has a flock of 300 hens valued at $120 how much is the tax on the flock if the rate is 15 mills?

8. If Ned has two calves worth $20 each what is the tax on them if the rate if 15 mills?

"Second Milers"

Ask your father for an old tax receipt. Note the various levies on the back of it and compute the total rate your father paid. Check the amount of his taxes to see if the receipt is correct. Ask your principal for the valuation of your school district and compute the amount of your school budget.

Lesson 4

INSTALLMENT BUYING

It is often desirable to buy something before one has money equal to the full purchase price. The firm having the merchandise to sell is frequently as eager to make the sale as the customer is eager to buy. Parties to such a transaction agree to a plan of deferred payments and the purchase is said to be made on the installment plan. In reality such a use of credit is installment paying.

It is the purpose of this assignment to help you discover the cost of such a convenience. The people of our nation have used the plan extensively--to some people it have been advantageous, to others it was folly. Try to discover some merits and weaknesses of the plan.

Problems

1. The author once paid $60 for a bicycle, paying $5 per month for one year. The bike could have been purchased at a cash price of $50. How much extra did the payment plan cost? If the $50 had been borrowed for one year what rate of interest would amount to the same cost? Is such an interest rate reasonable.

2. A certain mail order house advertises monthly payments on all merchandise as follows: on $15 order add $1.50, on $20 add $2, on $25.00 add $2.50. How much (what percent) is being added for the paying convenience? In the same advertisement the period of payments averages

about eight months, thus the privilege costs as much as what annual interest rate?

3. One finance plan for motor vehicles advertises its cost at 6% and works thus: purchase price $800, down payment $200, balance $600 at 6% makes the obligation $636 with twelve months to pay, hence each payment is $53. This first payment is really divided into $50 principal and $3 interest. How long has the $50 been borrowed? At 6% what is the interest for such time on $50? The $3 is how many times that amount?

4. To get a true picture of the preceding contract count up the number of months each $50 has been borrowed and add. (Is it 78 months?) What is the interest on $50 for such time at 6%? But $36 was paid for interest, can you discover the real and hidden rate?

5. A bill of a public auction sale reads "10% discount for cash or 8% interest on notes." Mr. A bids $100 to buy a fine dairy cow; he pays cash; how much must he pay? Mr. B bids the same amount for another cow and gives a note. How much does he pay at the end of a year? The final cost of Mr. B's cow is how much more than Mr. A's cow? The difference is what percent of the amount Mr. A paid?

6. An added charge of 10% for a pay period of six months is equivalent to what annual rate of interest? for an 8 months pay period? for 15 months? 18 months?

"Second Milers"

Is a piece of machinery worth more or less than the purchase price at the end of installment pay periods? Is the same true of young

live stock? How does this help you in deciding what to buy and what not to buy on deferred payment plans?

Make a list of ten articles you would like to buy. Star the items you think might be wisely bought on installment. Ask your teacher, parent or banker if money might be borrowed for such a purchase.

Write a paragraph of 100 words on why or why not to make installment purchases.

Lesson 5

RATIO AND DIVISION

It is quite natural for each of us to be interested in relations between things. Daily we hear such expressions as higher, heavier, older, more expensive. From your study of language you know that such words are in the comparative degree. When comparing numbers we may use either of two methods, viz. difference or ratio. The following table will illustrate the value of both methods in a few instances:

A.	B.	difference	ratio
4 Yr. 2 mo. old	2 mo. old	4 yr. older	25 times as old
3 ft. 4 in. tall	20 in. long	20 in. taller	2 times as tall
$12.50	50¢	$12 more	25 times as much
60 lb.	8 lb.	52 lb. heavier	7.5 times as heavy

After careful study of the comparisons you will agree that the ratio gives information that means more to the reader than does the difference. You have also discovered that ratio is a comparison by the process of division. Thus every fraction and every quotient is a ratio, either real or implied (understood). The fraction 6/8 may be reduced to a simple ratio which means to us 3/4 as much. Again, 36 in. divided by 12 in. gives the quotient 3. Since 36 in. equals one yard and 12 in. equals one foot, our quotient is an implied ratio which means to us that the dividend was 3 times the divisor or one yard is three times as much as one foot.

Problems

1. Fred's mother is 35 yrs. old and he is 7. What is the ratio of their ages?

2. Jane weighs 90 lb. and her brother on the college football team weighs 180 lb. What is the ratio of their weights?

3. A certain silo is 30 ft. deep and a cistern is 20 ft. deep. What is the ratio of their depths?

4. A farmer usually drives his car about 40 miles per hour, and his tractor 4 miles per hour. What is the ratio of the speeds?

5. Mary can wash the dishes in 20 minutes and her mother washes them in 15 minutes. What is the ratio?

6. Joseph sleeps nine hours each night while his baby brother sleeps twelve hours each day. What is the ratio of their sleeping hours? Joseph sleep s what part of each twenty four hours? The baby what part?

7. May walks from her suburban home to the high school in 20 minutes. Her brother walks the same distance, to a grade school in 25 minutes. What is the ratio of May's time to her brother's time? What is the ratio of May's rate to her brother's rate? (Beware, this one is not easy.)

8. John made $50 profit on a crops project. Wayne made $12.50 on a small garden. What is the ratio of their profits?

9. If 1 qt. = 2 pt. and 1 gal. = 4 qt., what is the ratio of 1 gal. to 1 pint?

10. If an acre equals 43,560 sq. ft. and a square rod is 272.25 sq. ft. what is the ratio of an acre to a square rod?

"Second Milers"

In problem one, as Fred and his mother grow older will the ratio of their ages remain the same? Try at least five examples to prove your decision. Will the difference in their ages, remain the same?

Lesson 6

VARIATION IN AREAS

Unless you have mastered Units VI, XI, and XX you have probably found difficulty in this unit. Particularly should you review them now in preparation for this lesson. The formula, cancellation and ratio are foundation stones to complete mastery of variation.

All of us know that one room is larger than another if they have the same width but the first is longer than the second. We wish to learn the secret of finding how many times as large it may be without having to compute the areas and divide.

Now what happens to the area of a rectangle if the length is doubled and the width remains unchanged?

Remember the formula $A = LW$.

Then W. represents the width of either rectangle and L is the length of the original and 2L the length of the enlarged. If A_1 be the area of the original and A_2 denote the area of the enlarged we have the ratio $\frac{A_2}{A_1}$ as equal to the ratio $\frac{2L \times W}{L \times W}$. When we cancel the letters we have the simple ratio 2 which means to us that the area has been doubled. We may be sure of it without troubling ourselves to learn either dimensions or area.

This plan of putting two formulas in ratio form and cancelling where possible may be used to compare any two areas whether they be similar in shape or not.

Problems

1. What happens to the area of a rectangle when the width is doubled and the length is unchanged?

2. What happens to the area of a rectangle when both length and width are doubled?

3. What happens to the area of a circle if the radius (or diameter) is doubled?

4. How is the area of a rectangle affected by doubling both base and altitude?

5. What is the effect upon the area of a rectangle if the length is doubled and the width is halved? (If in doubt, choose dimensions and prove your answer.)

6. What happens to the area of a circle if the radius is trebled? Is the diameter also trebled?

7. What happens to the area of a rectangle if both dimensions are trebled?

8. How is the area of a triangle affected if the altitude is doubled and the base is trebled?

9. How is the area of a rectangle affected if the length be trebled, the width halved?

10. Compare the areas of two circles whose radii are in the ratio of 3:2.

11. A two inch water pipe carries a stream how many times as large as an inch-and-a-half pipe?

12. A cow is tethered by a rope 2.5 times as long as a chain by which a goat is tethered. Compare their grazing areas.

"Second Milers"

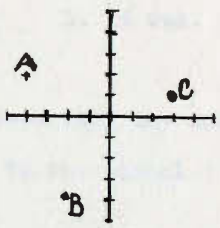
Doubling the perimeter of a rectangle has what effect upon the area?

Lesson 7

GRAPHS: CO-ORDINATE AXES

In mathematics the word graph means a picture of number facts or relations. Wherever you find the word, even as part of a larger word, it carries the idea of a record in writing or drawing, e.g., telegraph, photograph, barograph, autograph, biography.

To picture number facts it is necessary to use two guide lines: one vertical and one horizontal. Where these lines cross it is customary to call the zero point, the origin, or place of beginning for location of points. To locate a point it is necessary to give two numbers for distance and direction. By convention the first number is interpreted as distance to the right or left of the origin, that is on or parallel to the horizontal axis (guide line); the second number tells the distance above or below the origin, that is on or parallel to the vertical axis (guide line). Together the guide lines are known as axes.



By way of illustration let us consider the axes in the figure as highways leaving a city we shall call Omaha (same initial letter as origin.) As on a map we shall call upward north, leftward west, etc. Point A in the figure is four miles west and two miles north of O, showing where Albert lives. Bertha lives at Point B, which is two miles west and four miles south of Omaha. Charles' home is shown by

point C and is three miles east and one mile north of 0. Please note that distances east or west are given first, followed by distances north or south. These small numbers shown in parentheses are called co-ordinates, hence the name co-ordinate axes for the guide lines.

Exercises

1. On note paper prepare a set of co-ordinate axes. Number the units to 5, in each direction from the origin. Then locate the following points, and label properly by letter and co-ordinates:

A. 2 east, 5 north
B. 3 west, 3 south
C. 5 east, 5 south
D. 5 west, 1 south
E. 1 east, only
F. Only 4 north
G. Only 2 south
H. 4 west only

2. On another set of axes locate the residence of each farm boy and girl in class if 0 represents the nearest crossroad to the school building.

3. What is the first co-ordinate for everyone living on the N-S highway? What is the last co-ordinate for everyone living on the E-W highway?

"Second Milers"

Obtain an algebra textbook and find a lesson on co-ordinate axes. You will note that numbers east and south are called minus (-), numbers west and north are called plus (+). Such numbers are negative and positive. On a third set of axes locate the following points:

A. $+7, +2$
B. $-2, -2$
C. $-5, +4$
D. $+4, -5$
E. $+1, +1$
F. $0, 0$

Lesson 8

BOARD MEASURE

By far the most lumber is measured and sold in a unit called the board foot. Originally this meant a board one foot square and one inch thick. Any equivalent of 144 cubic inches of lumber may be called a board foot. Thus a 2" x 4" - 1.5' or 2" x 6" - 9" or 2" x 12" - 6" amounts to one board foot.

It is well to remember that lumber is usually measured in the rough and later planed so that it does not measure up to the full width and thickness often times. Even so-called dimension lumber is short by fractions of an inch. Ordinary flooring is considered 1" x 4" and lap siding is counted to be one inch thick.

The following formulas are use ful in computing quantities of lumber:

Basic Rule: Bd. Ft.= Pc x T" xW' x L'

Piece Rule: Bd. Ft.= Pc x T" x W" x L' ÷ 12

Running Foot Rule Bd. Ft.= T" x W" x L' ÷ 12

School Practice Bd. Ft.= Pc x T" x W" x L" ÷ 144

Key--

Pc= Number of pieces
W = Width
T = Thickness
L = Length

Bd. Ft. = Board feet
' = feet
" = inches

Problems

1. How many board feet in two planks, each 2" x 10" -12'? Transfers frequently carry such for loading pianos.

2. A farmer wishes to cross an oiled highway with his tractor. At least four planks, each 2" x 12" - 20' are required. How much lumber must he buy?

3. A porch is 4 ft. by 20 ft. with flooring laid the short way. To avoid waste a man bought twelve foot lengths. He estimates that twenty-five boards (1" x 4" - 12') will be enough. How much lumber in the boards? Would there be any waste?

4. At $2\frac{1}{2}$ cents per board foot find the cost of 18 - 2" x 4" - 10'.

5. At 6 cents per board foot find the cost of four white pine boards 1" x 10" - 6'.

6. What length of 4" x 4" contains just one board foot? How many board feet per lineal foot of 4" x 4"?

7. If lumber is 5 cents per board foot what is the price per lineal foot for 2" x 6" planks?

8. At 4¢ per Bd. Ft. find the cost of the following lumber:

5 - 2" x 4" - 10'
8 - 1" x 12" - 12'
12 - 2" x 8" - 12'

"Second Milers"

Lumber is frequently quoted at so much per M, meaning per 1000 Bd. Ft. Find the rate per board foot at the following rates per M: $125, $75, $45, $37.50, $22.50.

CHAPTER IX

APPENDICES

A. Number facts

B. Weights and measures

C. References

A-1 One Hundred simple addition facts 9for drill and review)

0 0	1 0	2 0	3 0	4 0	5 0	6 0	7 0	8 0	9 0
0 1	1 1	2 1	3 1	4 1	5 1	6 1	7 1	8 1	9 1
0 2	1 2	2 2	3 2	4 2	5 2	6 2	7 2	8 2	9 2
0 3	1 3	2 3	3 3	4 3	5 3	6 3	7 3	8 3	9 3
0 4	1 4	2 4	3 4	4 4	5 4	6 4	7 4	8 4	9 4
0 5	1 5	2 5	3 5	4 5	5 5	6 5	7 5	8 5	9 5
0 6	1 6	2 6	3 6	4 6	5 6	6 6	7 6	8 6	9 6
0 7	1 7	2 7	3 7	4 7	5 7	6 7	7 7	8 7	9 7
0 8	1 8	2 8	3 8	4 8	5 8	6 8	7 8	8 8	9 8
0 9	1 9	2 9	3 9	4 9	5 9	6 9	7 9	8 9	9 9

A-2 One hundred simple subtraction facts (for drill and review)

0 0	1 0	2 0	3 0	4 0	5 0	6 0	7 0	8 0	9 0
1 1	2 1	3 1	4 1	5 1	6 1	7 1	8 1	9 1	10 1
2 2	3 2	4 2	5 2	6 2	7 2	8 2	9 2	10 2	11 2
3 3	4 3	4 3	6 3	7 3	8 3	9 3	10 3	11 3	12 3
4 4	5 4	6 4	7 4	8 4	9 4	10 4	11 4	12 4	13 4
5 5	6 5	7 5	8 5	9 5	10 5	11 5	12 5	13 5	14 5
6 6	7 6	8 6	9 6	10 6	11 6	12 6	13 6	14 6	15 6
7 7	8 7	9 7	10 7	11 7	12 7	13 7	14 7	15 7	16 7
8 8	9 8	10 8	11 8	12 8	13 8	14 8	15 8	16 8	17 8
9 9	10 9	11 9	12 9	13 9	14 9	15 9	16 9	17 9	18 9

A-3 Table of Squares, Square Roots

No.	Squares	Square Roots	No.	Squares	Square Roots
1	1	1.000	51	2601	7.141
2	4	1.414	52	2704	7.211
3	9	1.732	53	2809	7.280
4	16	2.000	54	2916	7.348
5	25	2.236	55	3025	7.416
6	36	2.449	56	3136	7.483
7	49	2.646	57	3249	7.550
8	64	2.828	58	3364	7.616
9	81	3.000	59	3481	7.681
10	100	3.162	60	3600	7.746
11	121	3.317	61	3721	7.810
12	144	3.464	62	3844	7.874
13	169	3.606	63	3969	7.937
14	196	3.742	64	4096	8.000
15.	225	3.873	65	4225	8.062
16	256	4.000	66	4356	8.124
17	289	4.123	67	4489	8.185
18	324	4.243	68	4624	8.246
19	361	4.359	69	4761	8.307
20	400	4.472	70	4900	8.367
21	441	4.583	71	5141	8.426
22	484	4.690	72	5184	8.485
23	529	4.796	73	5329	8.544
24	576	4.899	74	5476	8.602
25	625	5.000	75	5625	8.660
26	676	5.099	76	5776	8.718
27	729	5.196	77	5929	8.775
28	784	5.292	78	6084	8.832
29	841	5.385	79	6241	8.888
30	900	5.477	80	6400	8.944
31	961	5.568	81	6561	9.000
32	1024	5.657	82	6724	9.055
33	1089	5.745	83	6889	9.110
34	1156	5.831	84	7056	9.165
35	1225	5.916	85	7225	9.220
36	1296	6.000	86	7396	9.274
37	1369	6.083	87	7569	9.327
38	1444	6.164	88	7744	9.381
39	1521	6.245	89	7921	9.434
40	1600	6.325	90	8100	9.487
41	1681	6.403	91	8281	9.539
42	1764	6.481	92	8464	9.592
43	1849	6.557	93	8649	9.644
44	1936	6.633	94	8836	9.695
45	2025	6.708	95	9025	9.747
46	2116	6.782	96	9216	9.798
47	2209	6.856	97	9409	9.849
48	2304	6.928	98	9604	9.899
49	2401	7.000	99	9801	9.950
50	2500	7.071	100	10000	10.000

A-5 Compound Interest. Amount of One Dollar Principal at Compound Interest

yrs.	4%	4½%	5%	6%
1	1.0400	1.1450	1.0500	1.0600
2	1.0816	1.0930	1.1025	1.1236
3	1.1249	1.1412	1.1576	1.1910
4	1.1699	1.1925	1.2155	1.2625
5	1.2176	1.2462	1.2763	1.3382
6	1.2653	1.3023	1.3401	1.4185
7	1.3169	1.3609	1.4071	1.5036
8	1.3686	1.4221	1.4775	1.5938
9	1.4233	1.4861	1.5513	1.6895
10	1.4802	1.5530	1.6289	1.7908
11	1.5395	1.6229	1.7103	1.8983
12	1.6010	1.6959	1.7959	2.0122
13	1.6651	1.7722	1.8856	2.1329
14	1.7317	1.8519	1.9799	2.2609
15	1.8009	1.9353	2.0789	2.3966
16	1.8730	2.1224	2.1829	2.5404
17	1.9479	2.1134	2.2920	2.6928
18	2.0258	2.2085	2.4066	2.8543
19	2.1068	2.3079	2.5270	3.0256
20	2.1911	2.4117	2.6533	3.2071
21	2.2788	2.5202	2.7860	3.3998
22	2.3699	2.6337	2.9253	3.6035
23	2.4647	2.7522	3.0715	3.8197
24	2.5633	2.8760	3.2251	4.0489
25	2.6658	3.0054	3.3864	4.2919
26	2.7725	3.1407	3.5557	4.5494
27	2.8834	3.2820	3.7335	4.8223
28	2.9987	3.4297	3.9201	5.1117
29	3.1187	3.5840	4.1161	5.4184
30	3.2434	3.7453	4.3219	5.7435
31	3.3731	3.9139	4.5380	6.0881
32	3.5081	4.0900	4.7649	6.4534
33	3.6485	4.2740	5.0032	6.8406
34	3.7943	4.4664	5.2533	7.2510
35	3.9461	4.6673	5.5160	7.6861
36	4.1039	4.8774	5.7918	8.1473
37	4.2681	5.0969	6.0814	8.6361
38	4.4388	5.3262	6.3855	9.1543
39	4.6164	5.5659	6.7048	9.7035
40	4.8010	5.8164	7.0400	10.2857
41	4.9931	6.0781	7.3920	10.9029
42	5.1928	6.3516	7.7616	11,5570
43	5.4005	6.6374	8.1497	12,5570
44	5.8412	6.2482	8.9850	12.9855
45	5.6165	7.2482	8.9850	13.7646
46	6.0748	7.5744	9.4343	14.5905
47	6.3178	7.9153	9.9060	15.4659
48	6.5705	8.2715	10.4013	16.3939
49	6.8433	8.6437	10.9213	17.3775
50	7.1067	9.0326	11.4676	18.4202

B-1 Units and Equivalents in Weights and Measures

1 acre.....43,560 sq. ft. = 160 sq. rd.
= 10 sq. ch. = 40.47 ares (metric)
1 barrel.....94 cu. ft. = 94 lb.
1 barrel cement.....4 bags = 3766 lb. = 3.76 cu. ft.
1 barrel flour.....196 lb.
1 barrel salt.....200 lb.
1 brick.....2" x 4" x8"
1 bushel (stroked).....2150.4 cu. in. = 1¼ cu. ft.
approximately 35.24 liters
1 bushel (heaped).....2688 cu. in. to 2747 cu. in.
1 bushel of coal.....80 lb.
1 centimeter (cm.).....3937 in. = 10 millimeters
1 cubic centimeter water.....1 gram (at 4° C.)
1 cu. in.....16.387 c.c.
1 cu. ft.....1/27 cu. yd. = .037 cu. yd.
= .0283 cubic meter
= 4/5 bu. = 7½ gal.
1 cu. ft. brickwork.....18 to 22 bricks
1 cu. ft. cement.....100 lb.
1. cu. ft. water.....62.43 lb. = 1000 oz. approx.
degrees Fahrenheit (F°).....F° = 9/5 C° -32°
degrees Centigrade (C°).....C° = (F° - 32°) 5/9
1 foot.....12 inches = 30.48 cm.
1 foot (board measure).....a board 1ft. square and 1 in. (or less)
thick
1 gallon.....4 quarts = 3.7854 liters = 231 cu. in.
1 gallon 20% cream.....8.4 lb.
1 gallon 22% cream.....8.339 lb. =-1 gallon water
1 gallon milk (3¼%).....8.6 lb.
1 gallon skim milk.....8.65 lb.
1 gallon water.....8.339 lb.
1 gross.....12 dozen
1 hand.....4 inches
1 hogshead.....2 bbl.= 63 gal.
1 inch.....2.54 cm. = 25.4mm.
1 kilogram or kilo (kg.).....1000 g. = 2.20462 lb.
1 kilometer (km.).....1000 meters = .62 mi.
1 liter.....1000 cc. = 244 cu. in. = 1.057 qut. (liquid)
=.908 qt. (dry)
1 meter.....39.37 in. = 3.3 ft.
.91 meter..... 1 yd
1 mile.....5280 fit. = 8 furlongs-= 320 rods
= 1.6 kilometers
1 millimeter.....039 in. = 1 cm.
1 oz.....28.35 grams
(avoirdupois)
1 pace.....3 feet.

(pi).....3.1416 (See p. 28)
1 pound (avoir.)...16 oz. = .4536 kilogram
1 quart (liquid)...95 liter (.9464)
1 quart (dry).....1.1 liter
1 rod.....16 ½ feet
1 square foot.....144 square inches
1 square inch.....6.5 square centimeters
1 ton.....2000 lbs.
1 ton of hay.....500 cu. ft. (varies from 450 cu. ft. to 550 cu. ft. depending on quality)
1 ton of coal.....25 bu. heaped (2688 cu. in.) = 38 8/9 cu. ft.
1 yard.....3 feet = .91 meter

APPENDIX C

BOOKS

Barnhardt, W. S. Maxwell, L. B.	Social Business Arith.	Metzen Bush & Co., N. Y.
Holton, E. E.	Shop Math.	Taylor-Holden Co., Springfield, Mass.
Roe-Smith-Reeves	Math for Agric. & Elem. Sci.	Ginn & Co., Boston
Stone, Jno. Co.	The Stone Arith. advanced	Benj. H. Sanborn Co., Chicago
Taber, C. W.	Business of the Household	J. B. Lippincott Co., Philadelphia.
Adams, Mary	Science in the Changing World	Century Co., N. Y.
Black & Davis	Practical Physica	Macmillan Co., N. Y.
Butler, A. M.	Household Physics	Whitcomb & Barrows
Henderson	New Physics in Everyday Life	Lyons & Carnahan, N. Y.
Hunter-Whitman	Problems in Genl. Science	Am. Book Co.
Thomson, J. A.	Riddles in Science	Liveright, Inc. N. Y.
Jones, Sam'l I.	Mathematical Wrinkles	
Strader-Rhoads	Plane Geometry p. 379 ff.	Kansas
Blackhurst, J. H.	Prin. and Meth. of J.H.S. Math.	Century Co., N. Y.
Breslich, Ernst R.	Problems in Tchg. Secondary School Math.	Univ. of Chicago Press
Brueckner, Leo. J.	Diagnostic and Remedial Teaching in Arith.	Jno. C. Winston Co., Philadephia
Judd, C. H.	Psychological Analysis of the Fundamentals of Arith	Univ. of Chicago Press
Osburn, W. J.	Corrective Arithmetic,	Houghton, Mifflin Co., Boston.
Thorndike, E. L.	Psych. of Arith.	Macmillan Co., N. Y.

TESTS

Educ. Test Bureau, Minneapolis, Philadelphia

Brueckner Diagnostic Tests in Arithmetic

Unit Scales of Attainment in Arithmetic

Public School Pub. Co., Bloomington, Ill.

Buswell-Johns Diagnostic Tests for Fundamental Processes in Arithmetic

Stevenson Problem Analysis Test

Scott, Foresman & Co., Chicago

Compass Diagnostic Tests in Arithmetic

Compass Survey Tests in Arithmetic

Knight-McClure Arithmetic Neatness Scale

Economy Remedial Exercises in Whole Numbers

World Book Company, New York

New Stanford Arithmetic Test

Otis Arithmetic Reasoning Test

C. A. Gregory Co., Cincinnati

Spencer Diagnostic Tests in Arithmetic

Clapp-Young Arith. Tests

Diagnostic Survey Tests in Computational Arith.

Los Angeles Diagnostic Tests in Fundamentals of Arith.

PART III

CHAPTER X

BIBLIOGRAPHY

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Complete course with introduction to business. An approved Kansas textbook.

Butler, Alfred M. Household Physics. Whitcomb & Barrows, 1914. 382p.

Just what the name implies.

Donham, S. Agnes. Spending the Family Income. Boston, Little, Brown, and Company, 1930. 174p.

One of the books analyzed by McCluskey, 1925.

Eaton, Theodore H. Vocational Education in Farming Occupations the part of the public high school. Philadelphia, etc. J. B. Lippincott Company, 1923. 374p.

Particularly Chapters X and XI.

Evans, Morris H. and Hall, L. F. Crops Project Book for use in Vocational Agriculture Courses in Kansas High Schools. Topeka, State Printer, (n. d.) 22p.

Approved by C. M. Miller, State Director Vocational Education. Universally used in Vocational Agriculture High Schools of Kansas for official record of individual (home) projects in crops production.

Evans, Morris H. and Hall, L. F. Live Stock Project Record Book for use in Vocational Agriculture Courses in Kansas High Schools. Topeka, State Printer, (n. d.) 30p.

Henry, W. A. and Morrison, F. B. Feeds and Feeding. Eighteenth Edition, unabridged. Madison, Wisconsin, The Henry-Morrison Company, 1923. 770p.

A handbook for the student and stockman. A reference commonly used in vocational agriculture courses in animal husbandry.

Holton, Edward E. Shop Mathematics. Springfield, Mass., The Taylor-Holden Company, 1910. 211p.

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Jones, Samuel I. Mathematical Wrinkles for teachers and private learners. Nashville, Tenn., Samuel I. Jones, Publisher, 1923. 328p.

Jull, Morley A. Poultry Husbandry. New York and London, McGraw-Hill Book Company, Inc., 1930. 639p.

A reference commonly used in vocational agriculture courses in poultry husbandry.

Kansas State Board for Vocational Education, Plans for Vocational Education in Kansas. Topeka, State Printer, 1927. 46p.

This is bulletin No. 7 of plans submitted by the state board and approved by the United States Board for Vocational Education.

Kansas State Board for Vocational Education. Problems involved in establishing departments of Vocational Agriculture in the public high schools in Kansas, Series A-1 (revised). Topeka, State Printer, Feb. 1936. 18p.

Markham, W. T. Course of Study for High Schools Part IX-Home Economics. Topeka, State Printer, 1936. 208p.
State of Kansas Department of Education Bulletin.

McCluskey, Mary Ola. An Analysis of the Mathematics Involved in Home Economics. Chicago. University of Chicago, 1925. Master's Thesis, 77p ms.
A study of the mathematics used by the woman in the home and by the student of home economics.

Plumb, Charles S. A Study of Farm Animals. St. Paul, Minn., Webb, 1922. 551p.
A reference commonly used in vocational agriculture courses in animal husbandry.

Pollom, Lester B. A Study of the Farm Mechanics Courses in the Vocational Agriculture High Schools in Kansas. Topeka, Kansas State Board for Vocational Education, Series A-3, November 1927. 45p.
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Rasor, Samuel Eugene. Mathematics for Students of Agriculture. New York, The Macmillan Company, 1923. 290p.

A textbook on the College level.

Roe-Smith-Reeves. Mathematics for Agriculture and Elementary Science. Boston, etc., Ginn & Co., 1928. 354p.

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Stone, John C. The Stone Arithmetic advanced. Chicago, etc., Benj. H. Sandborn & Co., 1926. 323p.

The approved textbook for arithmetic in the seventh and eighth grades of the public schools of Kansas for the past ten years and universally used in the rural areas of the state.

Taber, C. W. The Business of the Household. Philadelphia and London, J. B. Lippincott Company, 1918. 438p.

One of the books analyzed by McCluskey, 1925.

Thompson, Hazel E. Project Record Book for Vocational Home Making all day schools. revised and reprinted. Topeka, Kansas State Board for Vocational Education, 1934. 16p.

Universally used in the vocational home making departments of the high schools of Kansas for official records of individual student (home) projects.

Thompson, Hazel E. A suggest arrangement of units for Vocational Home Making All Day Schools. Topeka, Kansas State Board for Vocational Education, Series H-2 revised 1935. 12p.

A bulletin of suggestions compiled by the state supervisor of vocational home making.